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INTRODUCTION TO THE RADC R AND D COMPUTER FACILITY,(U)
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In-House Report
March 1977

INTRODUCTION TO THE RADC R&D COMPUTER FACILITY

Denis R. Maynard

ROME AIR DEVELOPMENT CENTER
AIR FORCE SYSTEMS COMMAND
GRIFFISS AIR FORCE BASE, NEW YORK 13441

This report has been reviewed by the RADC Information Office (OI) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be releasable to the general public, including foreign nations.

This report has been reviewed and approved for publication.

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This report is an introduction to the computer resources available in the R&D Computer Facility (ISF) of the Rome Air Development Center. This report contains a description of the individual systems with procedures to be followed to gain access to each.

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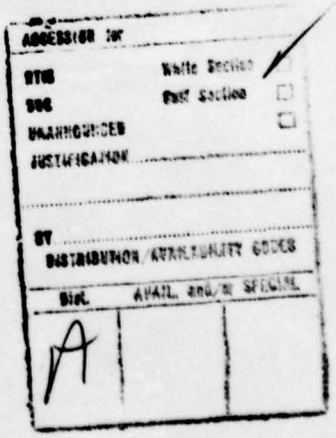
Abstract

This report is an introduction to the computer resources available in the Information Sciences Division (IS) to RADC personnel and contractors working on RADC projects. The procedures to gain access to the various systems are described. Also included are descriptions of the individual systems.

The following systems are discussed:

1) Honeywell 6180/MULTICS
2) Honeywell 6180/GCOS
3) RADC Associative Processor (RADCAP)
4) QM-1 Emulation System
5) PDP-11/45
6) Advanced Research Projects Agency (ARPA) Network.



PREFACE

This document is an updated version of a previously published description of the RADC R&D Computer Facility. While several contributions were solicited from other RADC personnel, the principle author of this report, who worked under the general guidance and direction of the Chief of the Facility Operations Office, Mr. Denis Maynard, is Miss Suzanne Dzwonkas. Miss Dwonkas is a computer programmer working under Utica College contract F30602-76-C-0155.

The author would like to thank several engineers and scientists within the Information Sciences Division for supplying information in their respective area of expertise. They include Richard Metzger, Thomas Lawrence, Oskar Reimann, Capt Alan Klayton, Armand Vito and John Faust.

Portions of the system descriptions were taken from Honeywell Manual BS01, Time Sharing General Information Manual; the "ARPA Computer Network Users Handbook" (MTR-6540) by Jean Iseli and Susan Poh; "RADCAP: An Operational Parallel Processing Facility" (GER-15946) by James D. Feldman and Oskar Reimann; and "Highlights of MULTICS System..." by A. A. Berglund, and J. R. Hannigan.

TABLE OF CONTENTS

INTRODUCTION

This handbook was written to introduce potential users to the computer systems available in the RADC R&D Computer Facility and to get them started on the system that best suits their requirements.

The first part gives an overview of the facility resources, defines eligibility for system usage, and sets forth the facility policy. The second part gives a brief description of the systems.

OVERVIEW

RADC/IS has a wide variety of computing systems available to the RADC community. These are:

1) Honeywell 6180 (MULTICS)
2) Honeywell 6180 (GCOS)
3) PDP 11/45 (OLPARS)
4) QM-1 Emulation System
5) Goodyear Associative Processor (RADCAP)
6) Access to more than fifty computers via the ARPA Network.

Each of these systems will be described in more detail in separate sections of this handbook.

For the statistically minded, in the main computer facility room there are two Honeywell 6180 CPUs, one million words of regular core memory, thirteen disc memory units with a capacity of 27.5 million characters each, eleven disc memory units with a capacity of 133.3 million characters each, three line printers, eight tape drives, two Datanet 355 communications processors capable of handling up to 200 teletypewriter channels simultaneously, but presently configured to handle about 81 time-sharing users, and an off-line plotter.

ELIGIBILITY

There are five classes of users of the computer facility. These are:

1) RADC personnel
2) RADC contractors
3) Department of Defense personnel
4) Department of Defense contractors
5) Others having obtained special permission.

All RADC personnel who require the use of a computer in the performance of their duties will be granted access and file space upon request. The procedure for making this request is stated in the interview section.

Since the MULTICS system is more ideally suited to the performance of R&D work and the GCOS system is best suited to the production level work, most R&D users will be encouraged to use the MULTICS system.

If it is determined that you would be best served by another system, the procedure will be documented in the section dealing with that system.

INTERVIEW

To gain access to any of the computers, the potential RADC user must first be interviewed by the Chief of the Facility Operations Office in Room 46 of Bldg. 3. When you attend this interview, you should know the Job Order Number(s) of the task(s) on which you will be working. If a user requires special handling, i.e., if you have a special application or project requiring other than normal services from the computer, you will be referred to the proper personnel for additional consultations.

The procedure for RADC contractors is essentially the same, except that they must be accompanied by the RADC project engineer when they attend the interview. (Note: ISFO coordination should have already been obtained as per RADC regulation 171-7 prior to any procurement action which specifies use of the Computer Facility. During coordination meetings, the best machine and the amount of computer resources to be allocated will be determined, and the conditions for using the facility's machines will be set forth. You must know the Job Order Number under

which the contract was signed as well as the contract number so we can assign you your account number.

```
**********************************************************************
*                                                                    *
*NOTE: RADC/IS WILL ASSIST WITH SYSTEM PROBLEMS, BUT DUE TO THE      *
*      SIZE OF OUR STAFF, WE CANNOT PROVIDE PROGRAMMING SUPPORT.     *
*      (SEE RADC REGULATION 171-7.)                                  *
*                                                                    *
**********************************************************************
```

Non-RADC users must request access in writing. Included in this letter should be your name, institution or organization, phone number, address, the name of the primary user(s), reasons for the request, and the approximate resource requirements (number of users). Address the letter to:

RADC/IS
Griffiss AFB NY 13441.

OPERATIONS

The personnel of the Facility Operations Office (ISFO) will help solve any system-type problems. For instance, if your program suddenly disappears or you cannot sign on, we will attempt to help you. However, as mentioned above, ISFO has a small staff and cannot service the programming problems that occur with 500 users. The following is a list of ISFO and related personnel, their speciality or job title, phone and room numbers. All are located in Bldg. 3.

ISFO Personnel

Name	Title	Room	Phone
Denis Maynard	Chief of Facility Operations Office	46	7628
Robert Doane	Operations Manager	46	7628
John Kalynycz, Jr.	GCOS System Analyst	212	2319
Don Elefante	MULTICS System Analyst	212	2319
William D. Jones, Jr.	MULTICS System Analyst	212	2319
Computer Operator	GCOS/MULTICS Operator	220	4043

Related Personnel

Name	Title	Room	Phone
Louis Comito	Chief of Facility Engineering Office(ISFE)	44	2242
Frank Troilo	Communications Support(ISFE)	44	2242
Oskar A. Reimann	RADCAP Support(ISCA)	31	4728
Tom Lawrence	ARPA Support(ISCA)	22	7746
Dick Metzger	PDP-11/45 Support(ISCP)	8	2846
Armand A. Vito	QM-1 Support (ISCA)	33	2904
Robert K. Walker	MULTICS On-Line Consultant	1051	2501

If you have an urgent problem with one of these systems, call the appropriate person and he will help you. If you have a question about something on the system there is a "help" command on MULTICS and an EXPLAIN command on GCOS. MULTICS also supports an "on-line-consultant" command to help with problems.

SCHEDULE

Because all of the computers here are used in support of the RADC research and development mission, the schedule on which they operate is necessarily a very flexible one. You can obtain the latest schedule on-line by entering the command "help schedule" on MULTICS or "Schedule" on GCOS. Also, if you have a project that requires special scheduling, due to a requirement for excessive or special resources such as more than an hour of CPU time, you should make arrangements with Mr. Doane in order that your requirements can be handled in the best manner for all concerned.

DOCUMENTATION

Honeywell publishes a comprehensive set of manuals on its system software and hardware. Many of these documents are available in either the main facility room or in room 75 for use on the premises only. Also, RADC/ISFO will order manuals for RADC employees. These can be signed for at the dispatch desk in the facility room. Non-RADC users must buy their own manuals directly from Honeywell. A Honeywell Publications Price Catalog is available in the facility or can be obtained from Honeywell at

no cost. The catalog number is AB81 and you can order it by writing to:

Honeywell Information Systems Inc.
Attn: Publication Services
40 Guest Street, MS339
Brighton MA 02135

From time to time, we will send out a newsletter called ISFO NEWS to inform users of major changes to our operating procedure.

ACCOUNTING/RESOURCE MONITORING

As has been stated earlier, any RADC employee with a legitimate need can use the facility's computers. Each use of the computer is automatically charged to a validated RADC JON. ISFO provides monthly billing reports of charges by JON.

The monthly bills detail each person's use of the facility's computers. The bills are distributed to the Project Engineer and any further distribution (e.g., to individuals or to contractors) is under his sole control. It is the RADC Project Engineer's responsibility to review these reports to ascertain that the computer resources used are consistent with the contractual and in-house tasks being performed under his project.

Inquiries on the Accounting System should be directed to William D. Jones, Jr. (x3877).

HONEYWELL 6180/MULTICS

INTRODUCTION

MULTICS (Multiplexed Information and Computing System) is the name of a general-purpose, time-sharing system originally developed by the Massachusetts Institute of Technology and financed by DOD/ARPA research and development funds. The system was originally implemented on the GE-645, an enhanced version of the GE-635. It is currently being run on the Honeywell 6180 here at RADC.

MULTICS was conceived and developed to:

- o Exploit virtual memory hardware and technology
- o Provide extremely secure operation
- o Provide a powerful system development tool
- o Provide for growth of itself and the subsystems and files in it
- o Provide continuous service.

FEATURES

Dynamic linking provides the capability of writing programs with conditional calls to large and sophisticated programs or error routines. Unless the call conditions are satisfied, the user will not have to pay the cost of locating, linking, and executing the called program.

Security of files from undesired access is assured through the unique use of a ring-structure. Programs and data as well as parts of the MULTICS system itself are assigned operational rings (domains of operation), and access permission is required in order that a program assigned to a given ring may cross into another ring. In all there are eight rings of which only the outermost are normally available to the user. The others are reserved for special use and system use.

MULTICS provides an hierarchical file structure and automatically protects user's files by performing an incremental dump to tape at one-half hour intervals with the results that a user should never lose more than a half-hour's worth of work due to a system malfunction.

Users access MULTICS via a multitude of commercially available computer terminals either directly or via the ARPAnet. Programs can be prepared, executed, and documented through an interactive keyboard interface which practically eliminates the need for a user to punch cards. One feature of interest is that corrected source statements may be entered at the terminal, compiled, and logically inserted into the executing program. The system does much of the work for the programmer, enabling useful program execution at the earliest possible point.

The user can also create an absentee job which is similar to a batch job on other systems. Absentee usage gives the user the ability to execute runs without waiting at the terminal while the run is in progress. For a complete description on absentee usage see the MULTICS Programmers Manual, Commands and Active Functions (AG92).

The MULTICS operating system is written in PL/I, a high-level programming language. This feature allows the sophisticated user to write his own additions to the operating system. Other languages supported are FORTRAN, APL, BASIC, COBOL 74, and the MULTICS utilities (text editors, file handling, etc.). The emphasis though is on PL/I, both as an applications language and as the system's own implementation language. A list of MULTICS software and features is included at the end of this section.

OPERATIONS

If it has been determined that MULTICS is the most appropriate system for your use, you will be referred to Mr. Donald Elefante for further information and orientation regarding system usage, schedules, user/facility problem interface, documentation, and restrictions (if any) on system use.

HONEYWELL SUPPORTED MULTICS SOFTWARE AND FEATURES

Absentee (Batch) Capability

Archiving - allows text archiving

Binder - provides preloading and linking for subroutine communication

Debug - interactive source debugging tool

CALC - desk calculator

Exec-com - powerful job control language

EDM - simplified text editor

Fortran - higher order language for math and science applications
GCOS Environment Simulator - supports GCOS batch programming environment

GUS - Graphics Users System

On-Line Library Users System

PL1 - higher level algebraic programming language

QEDX - powerful programmable text editor

Runoff - text formatting facility

Sort/Merge - very powerful sort and merge package

MULTICS Relational Data Store - programmer services for relational type of data base organization

MULTICS Integrated Data Store - programmer services for CODASYL/IDS II type of data base organization

APL - IBM developed engineering oriented language

NON-HONEYWELL SUPPORTED SOFTWARE

Tektronix Graphics Package (Plot 10 and AGII)

AVAILABLE MANUALS

AG90	MPM Introduction
AG91	MPM Reference Guide
AG92	MPM Commands and Active Functions
AG93	MPM Subroutines
AK92	Subsystem Writers' Guide
AG95	The MULTICS Virtual Memory
AG94	PL/1 Language Manual
AL40	MULTICS Users' Guide
AK95	APL Users' Guide
AM82	BASIC
AN05	GCOS Environment Simulator
AK15	MULTICS System Summary Description
AT58	DFAST Subsystem Users' Guide
AT59	DFAST/FAST FORTRAN Reference Manual
AU25	FAST Subsystem Users' Guide
AS43	COBOL Users' Guide
AS44	COBOL Reference Manual
AL39	Processor Reference Manual
AW17	Pocket Guide (Commands and Active Functions)
AM83	PL/1 Reference Manual
AW32	Sort/Merge Reference Manual

HONEYWELL 6180/GCOS III

A second Honeywell 6180 computer system uses the General Comprehensive Operating Supervisor III (GCOS III) operating system. Its features include resource management, job scheduling, database management, security control, multiprocessing, multiprogramming, and others.

TIME-SHARING SUBSYSTEM

GCOS III provides both time-sharing and batch operation. Time-sharing allows many remote users to use the computer resources interactively at essentially the same time. RADC's time-sharing system (TSS) can handle up to 64 simultaneous users. Users can access the computer by means of locally available computer terminals. Through these terminals users can perform operations from simple addition up to numerical analysis and report generation.

GCOS III comes with a wide variety of programming languages and service subsystems. These include FORTRAN; BASIC, a simplified but powerful language similar to FORTRAN; a powerful text editor; a system called CARDIN which allows time-sharing users to access the batch world from their terminal; SCAN, which allows users to peruse data and program files at his terminal; sort/merge programs; and an extensive applications library. A list of software is included at the end of the section on GCOS.

BATCH PROCESSING

RADC's H6180 is operated with simultaneous time-sharing and batch processing. The batch world can be accessed from time-sharing through a subsystem called CARDIN ; however, this section will deal with the standard mode of operation, i.e., programs and/or data submitted on cards or tape at the dispatch desk in the facility room (Room 54). Jobs are first assigned an identification number (called a "SNUMB", an acronym for serial number) and then transported to the operators who schedule and run them. The output is placed in boxes in the facility room for the user to pick up.

To use the H6180 as a batch processor, the user must have both a USERID and an account number (see section on Interview for procedure). The USERID and account number are both verified on the $IDENT card to assure that the user is an authorized one. If the USERID is incorrect or the $IDENT card is missing, the job will be aborted by the computer.

All users must submit an RADC Form 89 along with their jobs. These forms are available at the dispatcher's desk in the facility room (Room 54).

Jobs submitted before noon will normally be out by 1700 hours and those submitted after noon will be out the following morning. These are maximum times, and your job may be run sooner.

Tapes and cards needed in support of a user's work will be supplied by the facility. Tapes will be maintained in the tape library in the facility room. Mr. Richard VanDresar is the tape librarian and will help with any inquiries on the tape library you may have. Card storage is also available; the card library is also maintained by Mr. Richard VanDresar. Cards and tapes not stored in the facility will create serious problems for the user. Cards rapidly accumulate moisture, thus changing their size and more often than not, the card reader will literally "chew them up". Magnetic tape also changes physical characteristics, resulting in the inability of the tape handler to read the data. Off-line storage media (cards, tapes, and disc packs) require from 12-24 hours to become acclimated to the environment. Tolerances on the peripheral devices are extremely small, therefore the facility will not accept responsibility for user problems when media are not properly stored.

Key punch machines are available in various locations around the Center. There are two, an IBM Model 26 and a modified Model 29, in the facility room which are available on a first come-first serve basis. Cards punched on the Model 26 must undergo a transliteration when they are used on the Honeywell machines. This is accomplished by including a $INCODE control card in your deck (see Control Card Reference Manual, BS19, for details). The Model 29 has been modified to punch the Honeywell character set, thus eliminating the need for transliteration.

Note: do not try to interpret binary decks on these devices. Both your deck and our machine will be damaged.

A list of available software along with Honeywell order numbers is included at the end of this section.

GCOS SOFTWARE (Manual numbers are in parenthesis)

HONEYWELL SUPPORTED TIME SHARING

Abacus (BS01) - TSS acts as a desk calculator

Access (BS01) - Conversational file space management system

Basic (BR36) - Beginners All purpose Symbolic Instruction Code

Cardin (BR99) - Allows a user to enter a batch job from TSS

Data Basic (DA08) - terminal-oriented data processing

Fdump (BR99) - Word oriented file inspection/maintenance facility for permanent files regardless of format

JOUT (BR99) - TSS facility for manipulating batch output

RBUG (BR99) - Conversational debugging facility

Runoff (BR40) - Allows user to format a file printed at a terminal

SCAN (BR99) - Provides facility to conversationally examine output of batch jobs saved on perm files

Text Editor (BR40) - Text entry and manipulation system

HONEYWELL SUPPORTED BATCH

Algol (BS11) - Higher order programming language

BMD (BP82) - Bio-medical statistical programs

Bulk Media Conversion (BP30) - Converts jobs from one storage media to another

COBOL (BS08, BS09) - Higher order language used for business applications

Control Cards Reference Manual (BS19) - Job control language

File and Record Control (BN85)

FORTRAN(BJ67) - Higher order language used for math and science

G-225 Simulator (BQ02)

GMAP (BN86) - GCOS assembly language

Indexed-Sequential Processor (DA37) - Allows access of direct-access files in either a random or sequential mode

Integrated Data Store (IDS) (BR69) - COBOL/FORTRAN oriented file management system

Jovial (BS06) - Higher order programming language suitable for system building

Sort/Merge (BN87)

Source and Object Library Editor (BJ71) - Allows on-line creation of and maintenance of user libraries

System Library Editor (BS18) - Allows creation, modification and maintenance of system libraries

Transaction Processor (DA82) - Processes remote transactions

Utility (BQ66) - Used for operational and debugging purposes, permits copying, comparing, positioning, and printing storage-device data

Non-Honeywell Supported - Batch

GCS - West Point's device independent graphics package

SIMSCRIPT II.5 - An extended version of SIMSCRIPT from CACI, Inc.

ECSS II - Extended Computer Simulation System from the Federal Computer Performance and Simulation Center (FEDSIM)

RADC ASSOCIATIVE PROCESSOR

INTRODUCTION

In March of 1973, hardware was delivered to RADC in the form of a STARAN parallel processor with four arrays, a custom input/output unit (CIOU), a hardware performance monitor, and a variety of peripherals. Subsequently, the CIOU was used to interface STARAN with an 6180 I/O channel. At the same time, STARAN software was interfaced with the 6180 MULTICS operating system. The STARAN system can perform search, arithmetic, and logical operations simultaneously on any or all bit slices or word slices of its associative memory.

FEATURES

At present, the RADC Associative Processor (RADCAP) facility is totally operational and includes system software to allow for operation in both a STARAN stand-alone mode and an integrated STARAN/MULTICS mode. This means that

1) commands to the STARAN disk operating system can originate in MULTICS

2) the MULTICS storage system is available to STARAN users for program or data storage

3) a single task can use both machines to satisfy its processing requirements.

The system software is based upon a disk operating system and has a batch processing capability. In addition, language processing and operational software are available.

The basic objective of the RADCAP facility is to explore the performance of associative computer architecture on real-world, real-time problems. A specific goal is to determine the cost-effectiveness of associative/parallel processing in such an environment. Associative processing has been studied extensively in both theoretical and simulation studies, but no significant practical operating experience with them exists. Experimentation is necessary to provide "hard" data and fill in the presently

existing void. Practical operating experience also is required so that a general purpose associative processor configuration could be developed if results warrant it.

OPERATIONS

There are no restrictions or limitations on the use of the facility, other than it has to be used to conduct government business. However, as the user load increases, system use will be restricted by availability.

Orientation on how to use the system will be provided to intended users by RADCAP personnel. A limited number of RADCAP user manuals is available on request. Also available are descriptions of the RADCAP facility, its software and hardware.

After it has been determined that RADCAP is the best system for your needs (see section entitled "Interview" for procedure), you will be referred to Mr. Oskar A. Reimann (ext. 4728) for further information.

QM-1 EMULATION SYSTEM

INTRODUCTION

In November 1976 a QM-1 Emulation System was delivered to RADC. The QM-1 is an extremely flexible machine which can be programmed at two distinct microprogramming levels (Control store level, 18-bit words; Nanostore level, 360-bit words). System components include two magnetic tape units, a 60 M Byte disk unit, card reader, printer, cassette tape unit and a CRT console. The system contains 128K words of core, 16K words of semiconductor control store and 512 words of semiconductor nanostore. It is anticipated that the QM-1 will be interfaced to other RADC computer systems and will be accessible over the ARPAnet.

SOFTWARE

The QM-1 provides a basic operating system for writing, editing, running and debugging emulations. Assemblers for both levels of user microcode are provided. Once a system is emulated, the operating system for the emulated machine can be loaded. Emulations currently exist for such diverse machines as the IBM 360 and PDP-11/10.

At the present time there are no limitations on use of the QM-1 system other than it be used in support of government business. After it has been determined that the QM-1 system is best for your application (see section entitled "Interview" for procedure), you will be referred to Armand A. Vito (x2904) for further information.

PATTERN RECOGNITION DESIGN FACILITY

FACILITY OVERVIEW

The Pattern Recognition Design Facility consists of a collection of unique interactive software systems and associated hardware for the solution of target identification and signal classification problems. By coupling the skills of a human analyst with the power of a general purpose computer in an interactive mode, classification devices can be designed for operational systems utilizing real-world data.

The major elements of the Facility are an interactive system for waveform data analysis and feature extraction, entitled Waveform Processing System (WPS), and an interactive system for vector data analysis and pattern classification, entitled the On-Line Pattern Analysis and Recognition System (OLPARS). In addition, it contains an analog data processing capability, a feature extraction software system, and a long waveform analysis system.

FACILITY DESCRIPTION

Each of the elements of the facility can be briefly summarized as follows:

a. Analog Data Processing Capability

The nucleus of the analog configuration is an Applied Dynamics A/D-5 analog computer. The A/D-5 has been interfaced to the PDP-11/45 digital computer to provide a hybrid processing capability. The combined A/D-5 - PDP-11/45 system provides the capability to begin with raw analog data, particularly for pattern recognition problems, preprocess it in analog form, convert it to digital data, process it digitally and present it to the user via a high performance interactive graphics system.

b. Long Waveform Analysis System

The Long Waveform Analysis System is an interactive software system designed to digitize and display analog data. It is implemented on the PDP-11/45 computer with an analog to

digital converter, tape units, a time code reader, a disk and a Tektronix 4002A display with hard copy. The main purpose of the Long Waveform Analysis System is to be able to observe very long waveforms, and perform spectral analysis upon them.

c. The Waveform Processing System

WPS is an interactive graphics oriented computer system for the extraction of features from digitized waveform data. It consists of a library of mathematical algorithms and display options, to aid in the hypothesis, design and evaluation of feature extraction techniques for waveform pattern recognition problems. It is implemented on the PDP-11/45 computer with a Vector General display and control console.

d. The Feature Extraction Software System

The Hybrid Feature Extraction Software System (FESS) is implemented on a hybrid system consisting of the PDP-11/45, the A/D-5 analog computer, and the Tektronix 4002 display The main purpose of FESS is to generate a large data base of features from analog data after the features have been defined on WPS. This feature data base can then be used for classifier logic design on OLPARS.

e. The On-Line Pattern Analysis and Recognition System (OLPARS)

OLPARS is an interactive graphics oriented computer system for the solution of feature data analysis and pattern classification problems. It consists of a library of mathematical algorithms and display options to aid a human operator in determining the structure of the feature data and designing classification logic. OLPARS is resident on two systems. One version is on the PDP-11/45 under WPS. The second, and most powerful, is on the His 6180 computer under the MULTICS operating system with interactive graphics provided by a Tektronix 4002A storage tube. This system may be utilized by remote access through the ARPA computer network.

FACILITY HARDWARE

There are two hardware configurations which make up the Pattern Recognition Design Facility. One is built around the PDP-11/45 computer, while the other is built on the Honeywell 6180 computer.

The major hardware complex is composed of the PDP-11/45 digital computer,

a. Digital Equipment Corp. PDP-11/45 digital computer with 76K of core and the following options:

(1) Hardware floating point processor
(2) 7/9 track magnetic tape
(3) DEC tape
(4) fixed head disk file, 256K words
(5) cartridge disk file, 1.5 million words
(6) disk packfile, 10 million words
(7) analog to digital converter
(8) card reader
(9) digital plotter
(10) paper tape unit
(11) storage terminal
(12) image dissector camera

b. Vector General Graphics terminal with the following:

(1) 3-dimensional rotation, translation, scaling of display image
(2) light pen
(3) data tablet
(4) alphanumeric keyboard
(5) functions keys
(6) intensity modulation

c. Applied Dynamics analog computer with the following:

(1) 196 amplifiers
(2) 24 comparators
(3) function generators (including sine, cosine, dual log, and variable)
(4) digital logic (including flip-flops, gates, etc.)
(5) hybrid control
(6) A to D and D to A converters

d. Analog instrumentation including the following:

(1) analog tape units
(2) tunable filters
(3) spectrum analyzer
(4) probability and correlation analyzer
(5) strip chart recorder
(6) storage CRT display

The hardware is configured such that the operator utilizes the Vector General terminals as the primary control device for the problem's solution as it progresses. All of the pattern recognition software is written with the Vector General graphics terminal or the storage tube terminal as the controlling device. The analog computer is connected to the digital computer through a hybrid interface, thus allowing us the capability of processing in a hybrid mode. The analog tape units as well as the analog instrumentation allow the operator to begin with raw analog data and perform the required preprocessing as well as analog to digital conversion prior to the actual data analysis and processing within.

The second major hardware configuration is resident on the Honeywell 6180 computer under the MULTICS operating system. This configuration includes the MULTICS machine connected to two T4002 storage tube terminals by a means of 1200 baud modem interfaces. A GE TermiNet 1200, adjacent to one of the storage tube terminals, serves as a remote line printer.

Finally, there exists a direct hardware link between the PDP-11/45 and the Honeywell 6180. This will allow interchange of data between the two pattern recognition software systems, thus allowing the user to operate on whichever system is more amenable to the given problem at hand.

FACILITY USE

There are no restrictions or limitations on the use of the facility, other than it has to be used to conduct government business. However, as the user load increases, system use will be restricted by availability.

The following is a list of the possible ways in which the interactive pattern recognition technology developed by RADC/IS can be utilized:

a. Use of the Pattern Recognition Design Facility at RADC as GFE.

b. Remote usage of MULTICS/OLPARS over the ARPA Network or a leased line.

c. Acquisition of existing software from RADC to establish a similar facility at another geographic location.

d. Consultation and/or technical support by RADC/ISCP personnel for pattern recognition problem formulation, technical monitoring and evaluation of results.

Because this facility is not a "turnkey" operation, the user is also the computer operator. Therefore, it is imperative that potential users become qualified system operators before any utilization begins. Orientation on how to use the system will be provided to intended users by RADC/ISCP personnel. User's manuals for each of the elements of the facility are available on request. Also available are descriptions of the Pattern Recognition Design Facility, its software, and hardware.

After it has been determined that the Pattern Recognition Design Facility would be best for your application (see section entitled "Interview" for procedure), you will be referred to Dick Metzger for further information.

ADVANCED RESEARCH PROJECTS AGENCY NETWORK

The Advanced Research Projects Agency (ARPA) Network is a system of geographically separate, independent computers, called Hosts, and the communications network between them. It is designed to allow sharing of resources, information, and computer programs between any number of these computers. Presently, the system spreads from London to Hawaii with more than 50 sites and plans to include more in the future. Logical and geographic diagrams are included at the end of this section.

The RADC interface to the ARPA Network is a Terminal Interface Message Processor (TIP). This hardware unit, based around the Honeywell 316 processor, will accommodate two computers and 63 terminals. Currently an H6180 running MULTICS is connected to one computer port on the RADC TIP. Both the Associative Processor and the On-Line Pattern Analysis and Recognition System (OLPARS) are accessible through network front end processor software. It is expected to support the ELF system running the National Software Works (NSW) Front End package and also will be used to run the AFSCNET front end software which will be run on this PDP/11. Nearly half of the 63 terminal ports are in use, being connected to such devices as Execuports, Texas Instruments Silent 700, IMLACS and Terminet 300's.

The TIP will support asynchronous terminals either directly or modem connected through a standard EIA connector. The TIP hardware will support asynchronous internally clocked speeds (baud rates) from 75 to 2400 Baud for input and from 75 to 19,200 Baud for output.

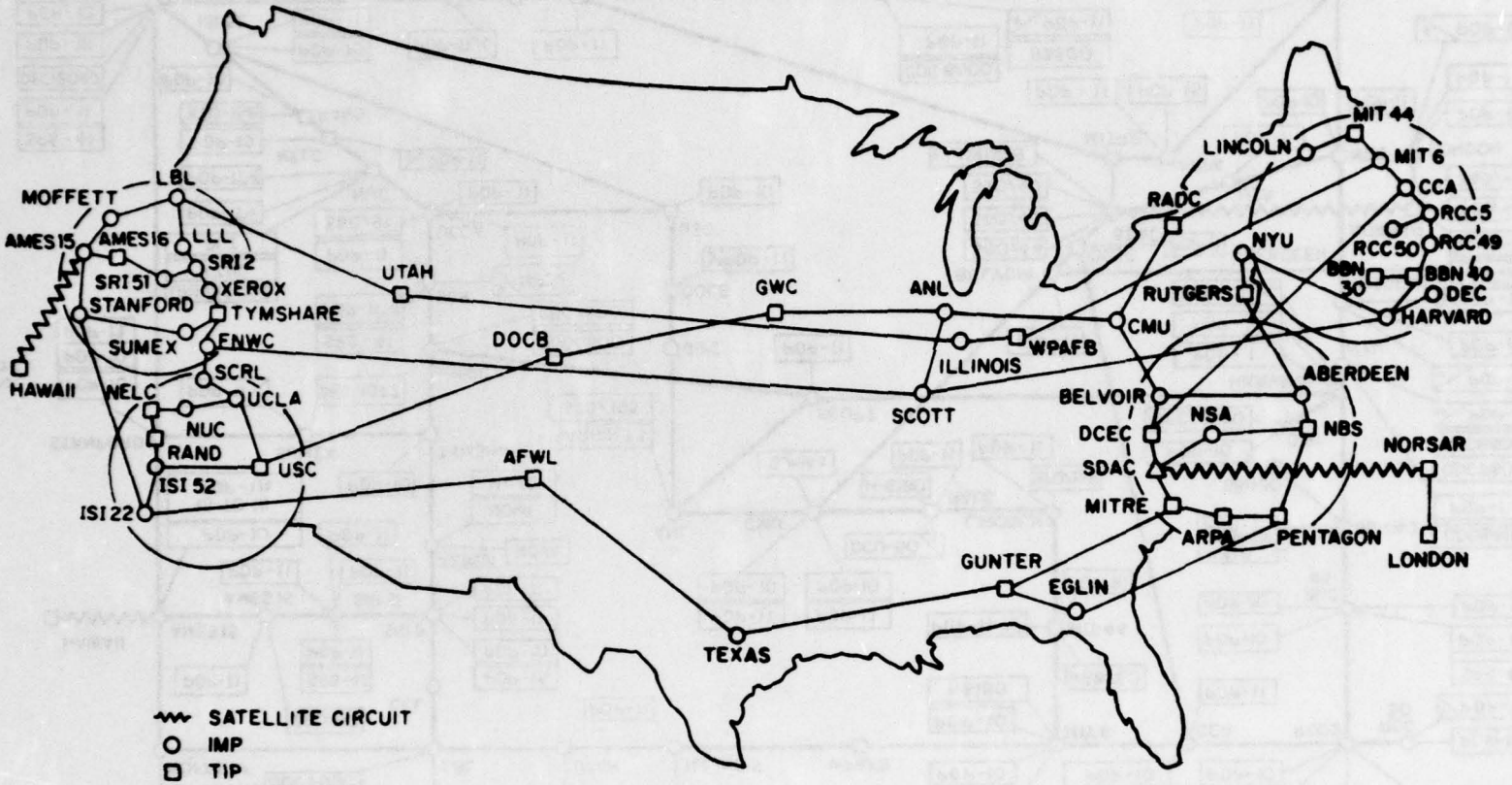
Some documentation on the ARPA Network including a Network Resource Notebook does exist in the Computer Facility (Room 54). The documentation on the Network resources is poor and would have to be supplemented by contact with the site of interest. If a user wishes to use the facilities on the Network, he has to make the necessary administrative arrangements with each site he may wish to use.

People wishing to use the RADC TIP are required to throughly describe their use of the network and further to obtain the necessary approval of that use through Tom Lawrence (RADC/ISCP). However, network users wishing to access the RADC MULTICS should contact Robert Walker (RADC/ISF). This review is necessary to properly administer a presently limited network facility and to make plans for future expansion if use dictates. This interview is in addition to the interview with Mr. Doane in the Operations

office (see section entitled "Interview" for procedure).

Users may pick up a copy of the TIP USERS GUIDE in the Facility (Room 54).

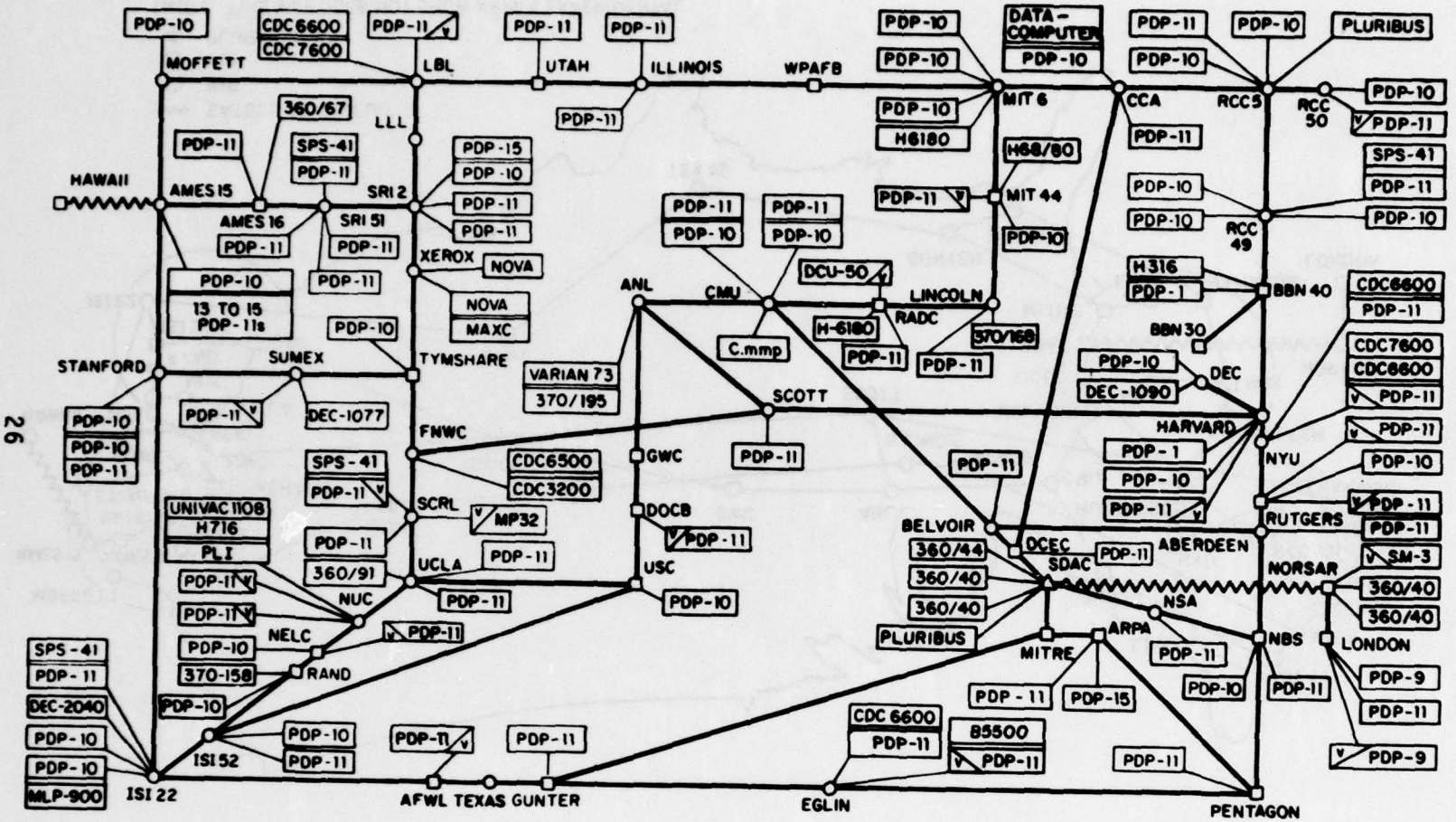
ARPANET GEOGRAPHIC MAP, DECEMBER 1976



(NOTE: THIS MAP DOES NOT SHOW ARPA'S EXPERIMENTAL SATELLITE CONNECTIONS)

NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

ARPANET LOGICAL MAP, DECEMBER 1976



(PLEASE NOTE THAT WHILE THIS MAP SHOWS THE HOST POPULATION OF THE NETWORK ACCORDING TO THE BEST INFORMATION OBTAINABLE, NO CLAIM CAN BE MADE FOR ITS ACCURACY)

NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

METRIC SYSTEM

BASE UNITS:

Quantity	Unit	SI Symbol	Formula
length	metre	m	...
mass	kilogram	kg	...
time	second	s	...
electric current	ampere	A	...
thermodynamic temperature	kelvin	K	...
amount of substance	mole	mol	...
luminous intensity	candela	cd	...

SUPPLEMENTARY UNITS:

plane angle	radian	rad	...
solid angle	steradian	sr	...

DERIVED UNITS:

Acceleration	metre per second squared	...	m/s
activity (of a radioactive source)	disintegration per second	...	(disintegration)/s
angular acceleration	radian per second squared	...	rad/s
angular velocity	radian per second	...	rad/s
area	square metre	...	m
density	kilogram per cubic metre	...	kg/m
electric capacitance	farad	F	A·s/V
electrical conductance	siemens	S	A/V
electric field strength	volt per metre	...	V/m
electric inductance	henry	H	V·s/A
electric potential difference	volt	V	W/A
electric resistance	ohm		V/A
electromotive force	volt	V	W/A
energy	joule	J	N·m
entropy	joule per kelvin	...	J/K
force	newton	N	kg·m/s
frequency	hertz	Hz	(cycle)/s
illuminance	lux	lx	lm/m
luminance	candela per square metre	...	cd/m
luminous flux	lumen	lm	cd·sr
magnetic field strength	ampere per metre	...	A/m
magnetic flux	weber	Wb	V·s
magnetic flux density	tesla	T	Wb/m
magnetomotive force	ampere	A	...
power	watt	W	J/s
pressure	pascal	Pa	N/m
quantity of electricity	coulomb	C	A·s
quantity of heat	joule	J	N·m
radiant intensity	watt per steradian	...	W/sr
specific heat	joule per kilogram-kelvin	...	J/kg·K
stress	pascal	Pa	N/m
thermal conductivity	watt per metre-kelvin	...	W/m·K
velocity	metre per second	...	m/s
viscosity, dynamic	pascal-second	...	Pa·s
viscosity, kinematic	square metre per second	...	m/s
voltage	volt	V	W/A
volume	cubic metre	...	m
wavenumber	reciprocal metre	...	(wave)/m
work	joule	J	N·m

SI PREFIXES:

Multiplication Factors	Prefix	SI Symbol
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^{9}	giga	G
1 000 000 = 10^{6}	mega	M
1 000 = 10^{3}	kilo	k
100 = 10^{2}	hecto*	h
10 = 10^{1}	deka*	da
0.1 = 10^{-1}	deci*	d
0.01 = 10^{-2}	centi*	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	μ
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p
0.000 000 000 000 001 = 10^{-15}	femto	f
0.000 000 000 000 000 001 = 10^{-18}	atto	a

* To be avoided where possible.

MISSION
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Rome Air Development Center

RADC plans and conducts research, exploratory and advanced development programs in command, control, and communications (C^3) activities, and in the C^3 areas of information sciences and intelligence. The principal technical mission areas are communications, electromagnetic guidance and control, surveillance of ground and aerospace objects, intelligence data collection and handling, information system technology, ionospheric propagation, solid state sciences, microwave physics and electronic reliability, maintainability and compatibility.